DOCUMENT RESUME

ED 061 328 TM 001 556

TITLE	Clicking-Machine Operator (boot & show; leather prod.) 6-62.055--Technical Report on Standardization of the General Aptitude Test Battery.
INSTITUTION	Manpower Administration (DOL), Washington, D.C. U.S. Training and Employment Service.
REPORT NO	TR-S-123
PUB DATE	Nov 57
NOTE	13p.
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	*Aptitude Tests; *Cutting Scores; Evaluation Criteria; Job Applicants; *Job Skills; *Machine Tool Operators; Norms; Occupational Guidance; *Personnel Evaluation; Test Reliability; Test Validity
IDENTIFIERS	Clicking Machine Operator; GATB; *General Aptitude Test Battery

ABSTRACT

The United States Training and Employment Service General Aptitude Test Battery (GATB), first published in 1947, has been included in a continuing program of research to validate the tests against success in many different occupations. The GATB consists of 12 tests which measure nine aptitudes: General Learning Ability; Verbal Aptitude; Numerical Aptitude; Spatial Aptitude; Form Perception; Clerical Perception; Motor Coordination; Finger Dexterity; and Manual Dexterity. The aptitude scores are standard scores with 100 as the average for the general working population, and a standard deviation of 20. Occupational norms are established in terms of minimum qualifying scores for each of the significant aptitude measures which, when combined, predict job performance. Cutting scores are set only for those aptitudes which aid in predicting the performance of the job duties of the experimental sample. The GATB norms described are appropriate only for jobs with content similar to that shown in the job description presented in this report. A description of the validation sample is also included. (AG)

ED 061328

FINAL REPORT

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TECHNICAL REPORT

ON

STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY

FOR

CLICKING-MACHINE OPERATOR (boot & shoe; leather prod.) 6-62.055

B-384

Die Cutter 699782

TM 001 558

U. S. Employment Service in
Cooperation with
Missouri and North Carolina State Employment Services

U. S. DEPARTMENT OF LABOR
Bureau of Employment Security
Washington 25, D. C.
August 1958

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EDUCATION & WELFARE
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GATB #863C,
741 and 859
November 1957

STANDARDIZATION OF THE GENERAL APTITUDE TEST BATTERY FOR CLICKING-MACHINE OPERATOR 6-62.055

B-384

Summary

The General Aptitude Test Battery, B-1001, was administered to two samples of workers employed as Clicking-Machine Operators 6-62.055. The state in which the sample was obtained, the number included in the final experimental sample, and the type of criterion used for validation purposes are shown below for each sample.

Sample	State	N	Criterion
I	Alabama and North Carolina	60	Supervisory ratings
II	Missouri	36	Supervisory ratings

Data for the two samples were analyzed separately and in combination. On the basis of the statistical and qualitative evidence, Aptitudes S-Spatial Aptitude and M-Manual Dexterity were selected for inclusion in the test norms.

GATB Norms for Clicking-Machine Operator 6-62.055 - B-384

Table I shows, for B-1001 and B-1002, the minimum acceptable score for each aptitude included in the test norms for Clicking-Machine Operator 6-62.055.

TABLE I

Minimum Acceptable Scores on B-1001 and B-1002 for B-384

B-1001			B-1002		
Aptitude	Tests	Minimum Acceptable Aptitude Score	Aptitude	Tests	Minimum Acceptable Aptitude Score
S	CB-1-F CB-1-H	80	S	Part 3	75
M	CB-1-M CB-1-N	85	M	Part 9 Part 10	80

Effectiveness of Norms

The data in Table IV-C indicate that 14 of the 23 poor workers, or 61 percent of them, did not achieve the minimum scores established as cutting scores on the recommended test norms. This shows that 61 percent of the poor workers would not have been hired if the recommended test norms had been used in the selection process. Moreover, 49 of the 58 workers who made qualifying test scores, or 84 percent, were good workers.

TECHNICAL REPORT

I. Problem

This study was conducted to determine the best combination of aptitudes and minimum scores to be used as norms on the General Aptitude Test Battery for the occupation of Clicking-Machine Operator 6-62.055.

II. Samples

This study is based on two samples of workers employed as Clicking-Machine Operators 6-62.055, by the Riegel Textile Corporation (plants in Alabama and North Carolina) and by the International Shoe Company (plant at Cape Giradeau, Missouri). The test norms were developed on the basis of the results of both samples.

Sample I - Alabama and North Carolina

The GATB, B-1001, was administered in November 1955 to 60 workers employed as Clicking-Machine Operators 6-62.055 in two plants of the Riegel Textile Corporation; 29 workers were tested at the Warlong Glove Company, a plant of this corporation in Newton, North Carolina, and 31 workers were tested at a plant in Brundidge, Alabama. Of the 60 workers tested, 10 were eliminated from the sample: 9 because they had less than a sixth grade education and one because he left before the training period was completed. Thus, the final sample consisted of 50 male workers.

Sample II - Missouri

During July and August 1952, the GATB, B-1001, was administered to 37 of the 75 Clicking-Machine Operators at the Cape Girarardeau, Missouri, plant of the International Shoe Company. Thirty-five of the 75 workers were eliminated because they were over 45 years of age, and 3 female workers were not included because women were considered to be less qualified than men for this occupation by the management. The remaining 37 male workers were tested. Of the 37 workers tested, one was eliminated because he had less than a sixth grade education. Thus, the final sample consisted of 36 men.

Table II-A shows the means, standard deviations, ranges and Pearson product-moment correlations (corrected for broad categories) with the criterion for age, education and experience for Sample I; Table II-B shows the means, standard deviations, ranges, and Pearson product-moment correlations with the criterion for age, education, and experience for Sample II. Table II-C shows the means, standard deviations, and ranges for age, education, and experience for the Combined Sample.

TABLE II-A

Means (M), Standard Deviations (σ), Ranges, and Pearson Product-Moment Correlations (Corrected for Broad Categories) with the Criterion ($_{c}r$) for Age, Education, and Experience

Clicking-Machine Operator 6-62.055
Sample I
Alabama and North Carolina

N = 50

	M	σ	Range	$_{c}r$
Age (years)	28.5	6.8	18-44	-.049
Education (years)	9.1	2.3	6-12	.192
Experience (months)	27.8	33.3	4-180	.140

TABLE II-B

Means (M), Standard Deviations (σ), Ranges, and Pearson Product-Moment Correlations with the Criterion (r) for Age, Education and Experience

Clicking-Machine Operator 6-62.055
Sample II
Missouri

N = 36

	M	σ	Range	r
Age (years)	29.7	7.0	17-45	.615**
Education (years)	10.4	1.7	8-14	.019
Experience (months)	78.7	82.9	3-362	.738**

** Significant at the .01 level

TABLE II-C

Means (M), Standard Deviations (σ), and Ranges for Age, Education, and Experience

Clicking-Machine Operator 6-62.055
Combined Sample

N = 86

	M	σ	Range
Age (years)	29.0	6.9	17-45
Education (years)	9.7	2.1	6-14
Experience (months)	49.1	64.4	3-362

The data in Table II-A indicate that there are no significant correlations between age, education, or experience and the criterion for Sample I. The data in Table II-B indicate that no significant correlation exists between education and the criterion for Sample II; significant correlations with the criterion at the .01 level were obtained for age and experience. There are several possible explanations for this linear relationship which was found to extend throughout the entire range of experience for this sample. It may be that: (1) raters were unconsciously biased in favor of the more experienced workers; (2) better workers tended to survive on the job while poorer workers tended to leave or were discharged because of inability to perform satisfactorily; or (3) worker proficiency continues to improve with experience on the job, though it is unlikely that the learning period would extend to as much as 30 years. Experience and criterion were plotted and there was no evidence of a leveling-off of the trend line. Because any or all of these factors may have contributed to the correlation, no correction was made for experience. The significant correlation between age and the criterion is probably due to the fact that since the experience range covers 30 years, there is a high correlation between age and experience. The data indicate that the two samples are suitable for test development purposes with respect to age, education, and experience.

III. Job Descriptions

Samples I and II
Job Title: Clicking-Machine Operator 6-62.055

Job Summary: Cuts parts for various leather products, such as gloves, boots, and shoes from hides, skins, or fabricated material, using clicking machine: Places material on cutting table of machine and positions appropriate die on material. Starts machine and drops arm onto die to cut material.

Sample I -- Alabama and North Carolina

Work Performed: Spreads leather to be cut into parts of gloves over cutting block above which is a free-swinging, cutting beam. Stretches leather and inspects it, feeling for thin places and other imperfections such as holes, scars, or brands.

Selects one of the dies provided (usually has from seven to twelve to select from) to obtain maximum cutting from the piece of leather. Places die over leather, pulls cutting beam from right to left and presses trip lever which brings hammer down with standard pressure on the die. Swings beam back to right.

Removes die and places it back on work table at left. Uses shears or knife to cut through completely any part not severed by the die, or pulls pieces apart with fingers. Places cut pieces in appropriate pile on table at right. Selects another die and continues cutting process, or may use same die for several cuts before selecting another die.

Either places cut pieces of each glove together in stacks, or places each different cut in individual stacks, watching to see that the separate stacks are growing at approximately the same rate to assure an equal number of parts at the end of the work period.

Must be able to select and place die to obtain the maximum number of cuts from a piece of leather with a minimum of waste.

Sample II -- Missouri

Work Performed: Reads case-lot (work order) ticket attached to bundle of hides to determine sizes and quantities of shoe parts to be made; selects cutting dies accordingly.

Lays one hide flat on cutting block of clicking machine, smooth (or hair side) up and carefully examines surface visually and with fingers to determine characteristics and imperfections (e.g. blemishes, thickness, smoothness, grain, over-all size, extent of areas found unsatisfactory or usable for the various shoe upper parts).

Places cutting die(s), selectively and successively one at a time on the positioned hide and in a manner that will utilize the examined material to the best advantages. Grasps handle of horizontally, rear-centered, pivoted ram-plate, swings it over the positioned die and trips the drive mechanism of the ram-plate by depressing the control handle causing ram-plate to quickly descend (and rise) forcing sharpened die through the material. Continues cycle of duties until requirement of case-lot ticket have been satisfied.

IV. Experimental Battery

All the tests of the GATB, B-1001, were administered to the samples.

V. Criterion

The criterion for Sample I consists of supervisory ratings in three broad categories. Broad category ratings in each plant (Alabama and North Carolina) were made by the Superintendent and the Foreman, after a conference with the analysts. The two sub-samples were regarded as comparable with respect to criterion data since the Personnel Director of all the company plants stated that a good worker in one plant was about the same as a good worker in the other plants. The broad category ratings of each subsample were combined for the final criterion. This placed 19 workers in the "high" group, 20 in the "middle" group, and 11 in the "low" group. For computational purposes the qualitative ratings were converted to quantitative scores of 60, 48, and 37, respectively. Supervisors in the Alabama plant also placed workers in rank order, however, since those from the North Carolina plant were not placed in rank order, the rank order ratings could not be used for statistical analysis. Average hourly earnings also were obtained for the Alabama and for the North Carolina samples, but were not used since earnings of all workers in the sub-samples were not obtained during the same period of time.

The criterion for Sample II consists of rank order ratings converted to linear scores. Workers in the sample group were listed in rank order by the department foreman. Primary consideration in making these ratings was given to quality and quantity production records. An independent rating of the workers was made by the assistant superintendent. The correlation between the two sets of ratings was .865.indicating a high degree of agreement between the two ratings. Ratings made by the department foreman were used for validation purposes because it was believed that the department foreman was in a better position to rate the workers on quality and quantity factors.

VI. Statistical and Qualitative Analysis

The data for the two samples were analyzed separately and in combination on the basis of both statistical and qualitative considerations. Means, standard deviations, and correlations with the criteria were calculated for the aptitude scores for each sample separately. Means and standard deviations of the aptitude scores were also calculated for the Combined Sample.

A. Statistical Analysis:

Table III-A shows the means, standard deviations, and Pearson product-moment correlations (corrected for broad categories) with the criterion for the aptitudes of the GATB, for Sample I. Table III-B shows the means, standard deviations, and Pearson product-moment correlations with the criterion for the aptitudes of the GATB, for Sample II. Table III-C shows the means and standard deviations for the aptitudes of the GATB, for the Combined Sample. The means and standard deviations of the aptitudes are

comparable to general working population norms with a mean of 100 and a standard deviation of 20.

TABLE III-A

Means (M), Standard Deviations (σ), and Pearson Product-Moment Correlations (Corrected for Broad Categories) with the Criterion ($_{c}r$) for the Aptitudes of the GATB

Clicking-Machine Operator 6-62.055
Sample I
Alabama and North Carolina

N = 50

Aptitudes	M	σ	$_{c}r$
G-Intelligence	90.2	15.2	.430**
V-Verbal Aptitude	82.8	12.7	.338*
N-Numerical Aptitude	92.1	17.7	.336*
S-Spatial Aptitude	97.5	19.7	.282*
P-Form Perception	90.1	20.8	.318*
Q-Clerical Perception	77.7	17.2	.303*
A-Aiming	81.9	15.0	.302*
T-Motor Speed	81.5	18.1	.278
F-Finger Dexterity	86.9	19.3	.306*
M-Manual Dexterity	94.0	20.0	.405**

** Significant at the .01 level
* Significant at the .05 level

TABLE III-B

Means (M), Standard Deviations (σ), and Pearson Product-Moment Correlations with the Criterion (r) for the Aptitudes of the GATB

Clicking-Machine Operator 6-82.055
Sample II
Missouri

N = 36

Aptitudes	M	σ	r
G-Intelligence	99.7	16.6	.371*
V-Verbal Aptitude	96.3	17.3	.235
N-Numerical Aptitude	102.3	15.4	.430**
S-Spatial Aptitude	103.4	16.9	.128
F-Form Perception	98.4	18.7	.107
Q-Clerical Perception	93.9	15.3	.250
A-Aiming	97.2	20.2	.011
T-Motor Speed	90.7	20.9	.121
F-Finger Dexterity	101.7	17.0	.207
M-Manual Dexterity	95.1	16.0	.349*

** Significant at the .01 level
* Significant at the .05 level

TABLE III-C

Means (M) and Standard Deviations (σ) for the Aptitudes of the GATB

Clicking-Machine Operator 6-62.055
Combined Sample

N = 86

Aptitudes	M	σ
G-Intelligence	94.2	16.5
V-Verbal Aptitude	88.4	16.2
N-Numerical Aptitude	96.4	17.5
S-Spatial Aptitude	100.0	18.8
P-Form Perception	93.5	20.4
Q-Clerical Perception	84.5	18.2
A-Aiming	88.3	19.0
T-Motor Speed	85.3	19.8
F-Finger Dexterity	93.1	19.8
M-Manual Dexterity	94.5	18.5

The data for Sample I, which appear in Table III-A, show that Aptitudes G and M correlate significantly with the criterion at the .01 level and Aptitudes V, N, S, P, Q, A, and F at the .05 level. Aptitude S shows that the highest mean score for this sample.

The data for Sample II, which appear in Table III-B, show that Aptitude N correlates significantly with the criterion at the .01 level and Aptitudes G and M at the .05 level. The highest mean scores in descending order of magnitude were obtained for Aptitudes S, N, F, and G.

Table III-C, which presents means and standard deviations of the aptitudes for the Combined Sample, shows that the highest mean score was obtained for Aptitude S.

B. Qualitative Analysis:

The job analysis indicated that the following aptitudes measured by the GATB appear to be important for this occupation:

Intelligence (G) - required in exercising independent judgment in selecting dies and in calculating number of cuts before the actual cutting process; in making calculations regarding production records periodically during workday, and in learning quality and characteristics of leather.

S-Spatial Aptitude (S) - required to determine the best selection of dies for the different glove parts and sizes, and the best placement of those dies in relationship to the given piece of leather in order to obtain the maximum number of cuts with a minimum of waste.

Finger Dexterity (F) and Manual Dexterity (M) - required to stretch and smooth leather, to handle, place, and remove dies speedily; to place cut leather sections in stacks quickly, and to swing beam over die and press trigger without loss of time.

C. Selection of Test Norms:

On the basis of the quantitative and qualitative evidence cited above, Aptitudes G, S, P, A, F, and M were considered further for inclusion in the test norms. Aptitudes G, S, F, and M, appeared to be important on the basis of the job analysis data. Aptitude S shows the highest mean score for Sample I; Aptitudes S, N, F, and G, in that order, show the highest mean scores for Sample II; and Aptitude S shows the highest mean score for the Combined Sample. Aptitudes G and M show significant correlations with the criteria for both samples; Aptitudes S, P, A, and F show significant correlations with the criterion for Sample I. Aptitudes V, N, and Q had correlations with the criterion significant at the .05 level in Sample I, but these aptitudes were not given further consideration forinclusion in the test norms because there was no other qualitative or quantitative evidence of significance.

Various combinations of Aptitudes G, S, P, A, F, and M with appropriate cutting scores were selected as trial norms. Means and standard deviations of the Combined Sample (N = 86) were used as guides to set cutting scores for these trial norms. The relationship between each set of trial norms and the dichotomized criterion for each sample and for the Combined Sample was determined by means of the tetrachoric correlation technique. The results showed that the selective officiency of norms consisting of S-80 and M-85 (B-1001) was as good as or better than the selective efficiency of any other set of norms tried for each sample taken separately and the Combined Sample. The cutting scores for Aptitude S and M are each within 10 points of one standard deviation below the mean for the Combined Sample.

In addition to the data for the above mentioned samples, data were also available for two other samples of workers performing the duties of Clicking-Machine Operator 6-62.055; one conducted by the Minnesota Agency and one conducted by the Wisconsin Agency. An attempt was made to develop a single set of norms for Clicking-Machine Operators based on the data from the four samples which were available. A comparison of the qualitative and quantitative data for these studies indicated that Aptitudes G, S, P, A, F, and M warranted further consideration for inclusion in the norms. Various combinations of these aptitudes with appropriate cutting scores were selected as trial norms. The selective efficiency of each set of trial norms was determined for each sample separately. No single set of norms resulted in good selective efficiency for the four samples combined. However, good selective efficiency was obtained for each of the two samples conducted by the Missouri and North Carolina Agencies and for these two studies combined. Therefore, the data for the two samples were used as the basis for establishing norms for Clicking Machine Operator 6-62.055.

VII. Concurrent Validity of Norms

In order to compute the tetrachoric correlation coefficients between the norms and the criteria and apply the Chi Square test, the criteria for the two samples were dichotomized. For Sample I, those workers who were in the "high" and "middle" groups were placed in the high criterion group, and those who were in the "low" group were placed in the low criterion group. For Sample II, those workers who had a linear score of 42 or more were placed in the high criterion group, all others were placed in the low criterion group.

Tables IV-A and IV-B show the relationship between test norms consisting of Aptitudes S and M with minimum scores of 80 and 85, respectively, and the dichotomized criteria for Sample I and Sample II, respectively. Table IV-C, which is a composite of Tables IV-A and IV-B, shows the selective efficiency of the norms for the Combined Sample. Workers in each high criterion group have been designated as "good workers" and those in each low criterion group have been designated as "poor workers."

TABLE IV-A

Relationship between Test Norms Consisting of Aptitudes S and M with Critical Scores of 80 and 85, Respectively, and the Criterion for Sample I

Clicking-Machine Operator 6-62.055
N = 50

	Non-Qualifying Test Scores	Qualifying Test Scores	Total
Good Workers	11	28	39
Poor Workers	8	3	11
Total	19	31	50

$r_{tet} = .64$ $\qquad$ $X^2 = 5.453$

$\sigma_{r_{tet}} = .25$ $\qquad$ $P/2 < .01$

The data in the above table indicate a significant relationship between the test norms and the criterion for Sample I.

TABLE IV-B

Relationship between Test Norms Consisting of Aptitudes S and M with Critical Scores of 80 and 85, Respectively, and the Criterion for Sample II

Clicking-Machine Operator 6-62.055
N = 36

	Non-Qualifying Test Scores	Qualifying Test Scores	Total
Good Workers	3	21	24
Poor Workers	6	6	12
Total	9	27	36

$r_{tet} = .65$ $\quad X^2 = 4.167$

$\sigma_{r_{tet}} = .29$ $\quad P/2 < .025$

The data in the above table indicate a significant relationship between the test norms and the criterion for Sample II.

TABLE IV-C

Relationship between Test Norms Consisting of Aptitudes S and M with Critical Scores of 80 and 85, Respectively, and the Criterion for the Combined Sample

Clicking-Machine Operator 6-62.055
N = 86

	Non-Qualifying Test Scores	Qualifying Test Scores	Total
Good Workers	14	49	63
Poor Workers	14	9	23
Total	28	58	86

$r_{tet} = .59$ $\quad X^2 = 9.768$

$\sigma_{r_{tet}} = .19$ $\quad P/2 < .005$

The data in the above table indicate a significant relationship between the test norms and the criterion for the Combined Sample.

VIII. Conclusions

On the basis of mean scores, correlations with the criterion, job analysis data, and their combined selective efficiency, Aptitudes S and M with minimum scores of 80 and 85, respectively, are recommended as B-1001 norms for the occupation of Clicking-Machine Operator 6-62.055. The equivalent B-1002 norms consist of S-75 and M-80.

IX. Determination of Occupational Aptitude Patterns

When the specific test norms for an occupation include two aptitudes, only those occupational aptitude patterns which include those two aptitudes with cutting scores that are within 10 points of the cutting scores established for the specific norms are considered for that occupation. Two of the existing 23 occupational aptitude patterns meet these criteria for this study. These occupational aptitude patterns and their B-1001 norms for OAP-13, which consists of S-80, P-75, and M-75; and OAP-14, which consists of S-85, F-95, and M-90. The selective efficiency of each of these OAP's for this sample was determined by means of the tetrachoric correlation technique. The tetrachoric correlation between OAP-13 and the dichotomized criterion for the Combined Sample was .40 with a standard error of .19 indicating a significant relationship. The proportion of the sample screened out was .30 which is used in counseling for the occupation of Clicking-Machine Operator 6-62.055. The tetrachoric correlation between OAP-14 and the dichotomized criterion for the Combined Sample did not indicate a significant relationship.